

# SCOPE OF WIRELESS POWER TRANSFER TECHNOLOGY IN UPCOMING GENERATION

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## **ABSTRACT:-**

The transmission of power without wire is a latest technique to transmit power wirelessly. The transmission of power without wire helps in connecting the people living in backward areas where power supply is not suitable. Anyone is free to get clean and eco friendly wireless power. In the future, every device will adopt the wireless power supply. Through this article, I have represented the experimental attempts which were successful to transmit power without wire and the scope of transmission of power wirelessly in upcoming future. We have made effort to give a look of the range of transmission of power wirelessly in upcoming time in different places where transmission of wireless power is difficult to be implemented.

**Keyword:** - Power beaming, Satellite of Solar power, Magnetic fields, Electromagnetic field, Electrical vehicle, Transmission of Wireless Power.

## **Introduction**

In the present time, all type of power is transmitted through wire from power station to whole world. The technology of transmission of power without wire has ability to decrease our dependence on batteries and wires. The transmission of power without wire has ability to give power to electrical devices in those areas in which it is a big issue in the implementation of wire transmission is hazardous, inconvenient, and not possible. The technology of transmission of power without wire has ability to decrease the application of electrical wire which is mainly constituted of aluminum and copper metal. In the future these metals which are being used in constructing electrical wires will be vanished from the earth. The technology of transmission of power wirelessly will decrease our dependence on electrical wire. It would be beneficial, if in the future we can implement the technology of transmission of power wirelessly to transfer power from power stations to everywhere without any wire requirement. In 2nd section, various categories of the wireless power, the technique is considered, whereas the 3rd section provides detail of different proofs of experiments related to transmission of wireless power, the section 4th provides us detailed information about the various applications related to transmission of wireless power and at the end, the section 5th describes the application strength of the technology of transmission of power without wire in the future.

## **The Categories of the technology of transmission of power wirelessly**

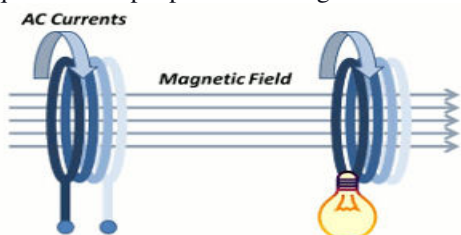
**Non imitable:** In the near scope or non-imitable techniques, through magnetic-fields, power of coil's wire can be transmitted through shorter distance by making use of coupling which is inductive, or through electrical fields using coupling which is capacitive in the midst of electrodes of metal. In wire free technology, the coupling which is inductive is prominently used in; tags of RFID, electric tooth brushes and phones, chargers for inculcating medical devices like electric vehicles or artificial cardiac pacemakers are involved in its category.

**Near-field transmission:** In near range, the transfer of coupling within two coils is necessary for the transmission of power. Through the fields of magnetic coupling, the energy is being transferred wirelessly, although being invented with more than a century ago. The transmission of drops is done efficiently as well as in large amount if the iron core is removed and the two coils are set apart.

This is the reason due to which both the coils are placed very close to each other. These types of methods have been previously launched in the market. For example, most of the electrical toothbrushes are now using chargers which are

wireless, which are very much safe than the cable chargers in climate which has large amount of humidity in it.

The frequency of receiver coils and the transmitter coils is set on through the shape of coil and the material of the coil, the transfer efficiency will keep on decreasing much more slowly as the distance between them is increased. A group led by Prof. Marin Soljacic from MIT, has gained the success in transmitting electric energy (60 Watt) between two coils more than two meters apart through a non divergent electromagnetic field, as given in Figure 1. Almost there is no interference with radio, TV, or signals of Wi-Fi which happens in the near or close field normally working at 50Hz to 60Hz. The great problem is that this transmission has a hazardous influence on the human health. But as it is known to all that all the material with which human body parts are made up of non magnetic, so it concludes that they are unable to interact with magnetic field, even several types of Tesla that are unable to interact with magnetic field, even several types of Tesla that are present in the modern MRI machine. Such types of magnetic-fields are there which are quite safe to people within range the transfer.



**Figure 1:** Transferring energy by magnetic field by coupling between two coils with the same frequency of resonance.

### Radiative

In wide-field or divergent techniques, power is transmitted through beams, like laser beams or microwaves are known by power beaming. The techniques of power beaming can transmit energy longer distances. Drone aircraft which is powered wirelessly and Solar power satellites are proposed applications.

**Far-field transfer:** For wirelessly energy transmitting, the far-field transfer had been used over long ranges.

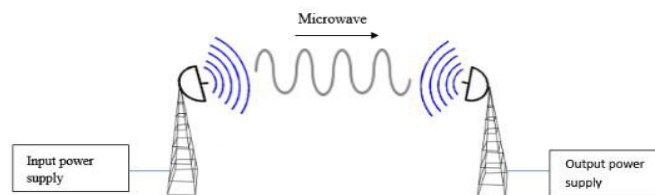
• **Microwaves:** In far-field radiative electromagnetic waves is used. There is another method that uses waves of electromagnet in various kind of wavebands. Previously, there were several experiments with microwaves and radio. For getting adequate directionality, the antennas wavelength should be longer. There is a requirement of light's speed in the air should be approx  $3 \times 10^8$  m/s and the wavelength of microwaves and radio should be approx 1 meter for an antenna with a dimension of several meters to several kilometers. Small wavelengths are used for transferring energy in smaller objects. Wavebands of radio, Wi-

Fi, cell phone and TV which low intensity of signal, multiple orders of larger magnitude, the waves of electromagnet is been used.

• **Lasers:** In Figure 2 represents power transmission by the conversion of electricity into laser beam, in electromagnetic field. Then it can be noted at photovoltaic cell. In this case, power can be changed into electrical energy by beaming at the receiver of power. This mechanism of converting power into electrical energy is known by 'power beaming' technology. The optimization of converters of photovoltaic laser power for conversion of monochromatic light, put in at the receiver. These kind of technology has been used in aerospace applications and military weapons.

### Various Experimental Proof of Transferring Power Wirelessly

- In 1894, Nikola Tesla had used coupling of Resonant inductive, that is also referred as "electro-dynamic induction" for wirelessly light up incandescent lamps and phosphorescent, that was existed at the laboratory of 35-South Fifth Avenue and further in New York City at the laboratory of 46 E. Houston Street. In 1897, a device was licensed by Nikola Tesla, called the high-voltage.
- In an experiment that was held in 1910 by using white hot light-powered by electromagnetic induction wirelessly. In an electro magnet, a wired coil with the alternate current in it was used for the creation of a large cylinder's bottom that generates a magnetic field. The lamp is then attached with another wired coil that is at the top of magnet's pole. For the lighting of the lamp, electricity had generated by the magnetic field. The lamp then seems as an actual Edison lamp including a filament of carbon.



**Figure 2:** Electric energy is being transmitted to a powerful beam of microwave or radio wave by using an antenna, that travels through the atmosphere, and received through another antenna that returns it back to the output power supply.

- In 1964, Mr. Brown invented Rectenna which could replace microwaves to Direct Current power efficiently, and in 1964, the first aircraft that was powered wirelessly demonstrated, which is a helicopter's model that was powered by beams of microwaves from the ground.

- In 1975 California, high-power transmission Wirelessly through using experiments of microwave using 10 kilowatts of electricity had been performed in Goldstone.
- In 1983, Hiroshi Matsumoto's team has invented the 1<sup>st</sup> experiment of MPT in space. The name of experiment was (MINIX) Microwave Ionosphere Nonlinear Interaction Experiment.
- The Experiment of the airplane flight that was fuel-free, succeeded by the group of Canadians with MPT which was elaborated by Stationary High-Altitude Relay Platform (SHARP) with 2.45 GHz in 1987.
- Several field experiments of MPT have been arranged since many year In Japan. The experiment of flight which was fuel-free was conducted successfully by a collaborative group that was using technology of phased-array, that was elaborated as the MILAX (Microwave Lifted Airplane Experiment) in year 1992.
- In New Zealand, From the Auckland University, Professor Grant Covic and Professor John Boys invented several systems for transferring huge amounts of energy across tiny air gaps in 1993. In Japan, this system was practically used as the AGV non-contact power supply and moving crane.
- In the year 1994-1995, power companies and universities made a Ground-to- Ground MPT experiment.
- In the year 1997, the experiment of transmission of Microwave Power was conducted on Reunion Island at Grand Bassin.
- In the year 2003, a lightweight replica of plane, which is being powered using laser beams that were demonstrated in NASA's Dryden Flight Research Center.
- In the year 2006, Marin Soljačić together with the coordination of other researchers at Massachusetts that was the Institute of Technology had applied a concept in electromagnetic theory was the concept of transmission of power without wire which was based on toughly coupled resonators.
- In 2008, a demonstration of Microwave Power Transmission through long-range was realized on the island of Hawaii. The demonstration and involvement of the wirelessly energy transmission was arranged by Managed Energy Technologies.
- An Online Electric Vehicle OLEV that was an electric transport system has been made by the Researchers at the KAIST'S University. Cables using non-contact magnetic charging were used in the vehicles to get power wirelessly. These cables are sealed under the surface of the road. This technique helps in improving the efficiency by decreasing energy usage and for managing traffic congestion.
- In the year 2009, the researchers at Advanced Institute of Technology and Science, the Korean University has successfully experimented using a bus by transferring 60% power with a gap of 12 cm and also in 2009, In the group experiment of Kyoto University which was based on idea of airship to ground including two phased-controlled magnetrons.
- In the year 2013, an American physicist named Hatem Zeine is the inventor, who demonstrated and explained how transmission

of power wirelessly by using antennas of phase array can transfer electrical power upto 30 feet.

- In the year 2015, the Researchers of Washington's University has experimented a power over Wi-Fi, that covers the range to the height of 20 feet. They also performed an experiment using Wi-Fi which was based on lithium-ion coin-cell batteries and wirelessly transmission of trickle-charge nickel-metal hydride to the distances till 28 feet.

- (Federal Communication Commission ) FCC had certified the first radio frequency (RF) in the mid-field whose transmission of power is wireless in 2017.

#### Applications of Transmission of Power wirelessly

**Transmission of power to the transportable devices wirelessly:** The Figure 3 given below shows that the overall system is made up of charger pad and a battery. For transferring energy to the battery from charging pad, every part is having a planar coil. When the battery and charging pad communicate with one another then electricity is modulated. Before charger pad transmits full power to the battery, it verifies whether a valid battery is in its correct place or not. This communication phenomenon continues till the battery is its correct place.



**Figure 3:** Wireless Charging of transferable device using inductive coupling.

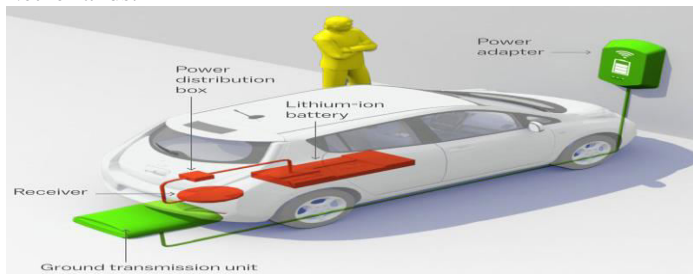
#### Wirelessly charging of the electric vehicle

According to Figure 4, a charging pad is placed on the ground which is connected to the wall mounted power adapter. All car parking is done above it. At the backside of the car, a receiver is present. When the charger detects the receiver under its range, it starts charging automatically.

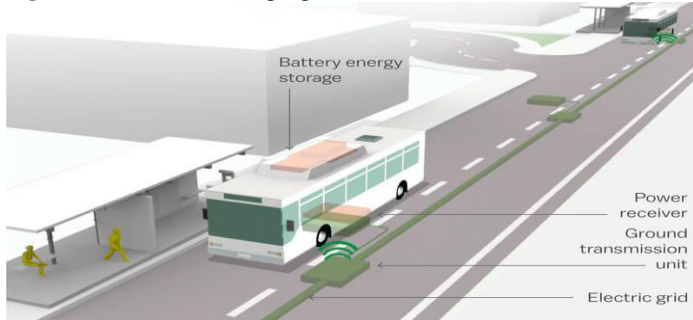


### Wirelessly charging of public transport

Every electric auto or bus has a wireless charging receiver. According to Figure 5, Wireless chargers are placed under the hard surface of a road with the definite gaps between them. When the bus is stopped then there is no need to plug in or no use to connect it with wireless chargers. It will be automatically charged. It is a motion bus. These types of buses are already been verified in the Italy, UK, South Korea and Netherlands.



**Figure 4:** Wireless Charging of Electronic vehicle.



**Figure 5:** Wirelessly Charging of public bus.

### Wirelessly charging lane for Self-driving electrical vehicle

Figure 6 defines vehicles can easily park for some time after returning to charge their batteries by doing use of wireless charging pads in curbs, parking Garages, lanes, and for self-driving.

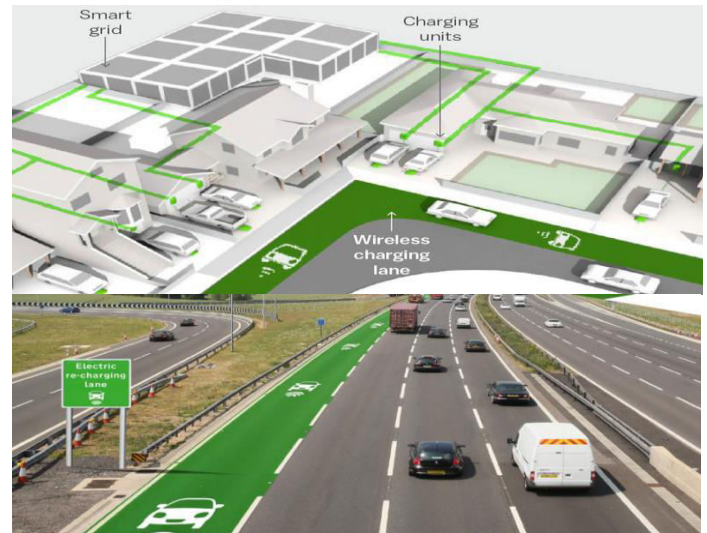
### Future scope of power transmission technology without wire

In the future, we can use electric appliances by using electricity without wire. In the below, discussing some potential scope of using wireless power transfer technology.

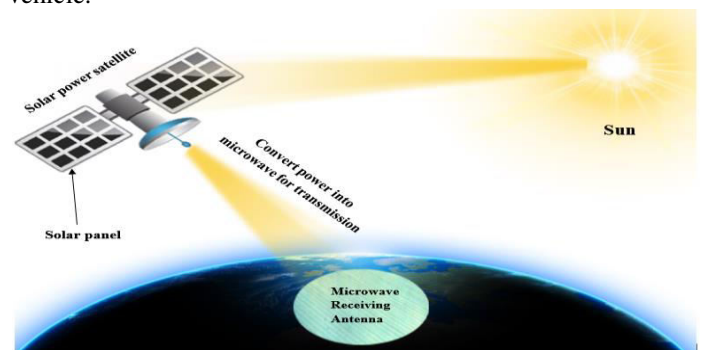
### Solar Power Satellite

The satellites with the solar panels are used to capture the maximum amount of sun light from the sun in the space. The satellite consists of a microwave transmitter which is used to convert power into the microwave for transmission. According to Figure 7 transmission of micro-waves from the satellite which is present in space is being received through microwave receiving antennas that are situated on the earth. These

microwaves receiver antenna receives microwave and then converts it into electricity. Then this electricity is used to power home and office etc.



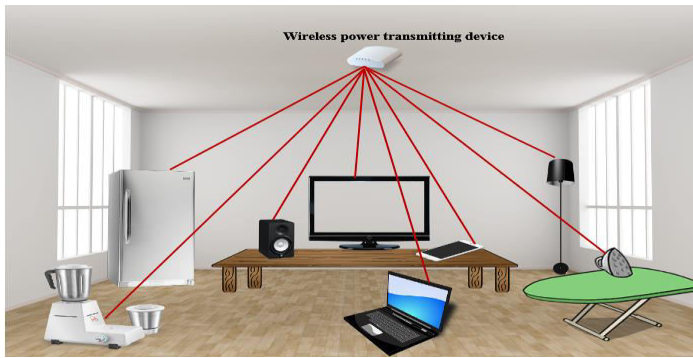
**Figure 6:** Charging lane without for the self-driven Electric vehicle.



**Figure 7:** Transmission of power without wire of micro-wave from space to the earth with the help of solar power satellite.

### Wirelessly powered home appliances

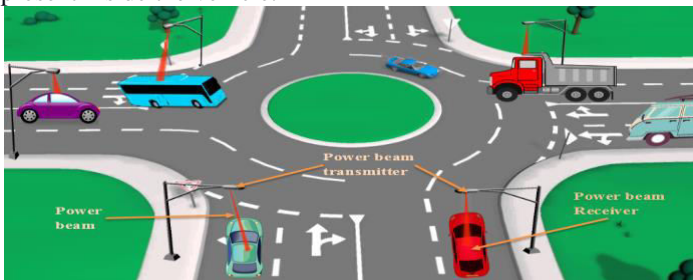
In the future, the transmitting device will be there inside the house, through which transmission of power will to all other home appliances like Laptop, Television, Iron, Lamp, Fridge, Sound Box, Mobile, etc. as shown through the Figure 8. Transmitting devices transmits power with the help of transmitter and all the other appliances will receive that power through their receiving devices which are set up inside all appliances.



**Figure 8:** Transmission of power wirelessly from transmitting device to the receiving devices of different appliances.

### Wirelessly charging of electrical vehicles on the way

According to Figure 9 in the future, there would be no use to stop and charge the electrical vehicles. Charging could be done on the way. According to this concept, power beam transmitters will be connected to the highways, dense traffic areas with the power source which converts electricity into the beams of power and then these beams will be transmitted to the electrical vehicles which are consisting of power beams receivers which in turn converts these beams of power into electrical power for the charging their batteries which are present inside the vehicle.



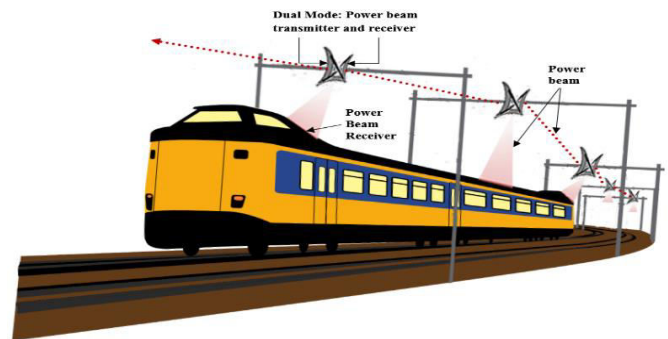
**Figure 9:** The charging of electrical vehicles on their way wirelessly.



**Figure 10:** Communication through power source without wire in emergency.

### The universal power source in the emergency

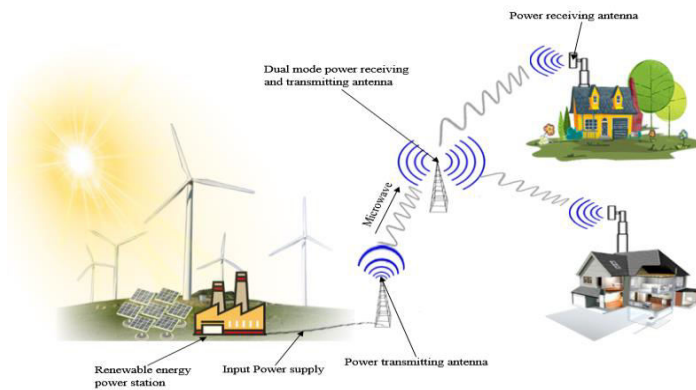
In an emergency or disaster situation where all the communication medium and power system has broken down. Immediate communication after a disastrous situation is the most important part of response and recovery; it connects disaster affected people, families, and communities with the support system or to the other family members. In this situation, an emergency power source may help to provide necessary power sources to power their communication devices so that they can easily connect with their family and rescue services as it is shown in Figure 10. A universal power source consists of an airship built-in power transmitter that acts as power source and drones; which consists of the power transmitting and receiving devices which provides basic communication as well basic wireless power to the affected people, home appliances.



**Figure 11:** Future of wirelessly powered electric train.

**Wirelessly powered train:** As given in Figure 11 that there will be no necessary to connect the wire with the train in order to get charged. In these types of systems, a dual-mode power transmitter and receiver will be connected to the pole and each station will have single pole with the dual-mode transmitter and receiver. Power which comes through the power station is captured in the dual-mode transmitter and transmits power. By doing use of the dual-mode transmitter, the power capturing and power transmitting phenomenon happen continuously. These types of powers will be received by the receivers which are fixed on the ceiling of the train. This process is done wirelessly.





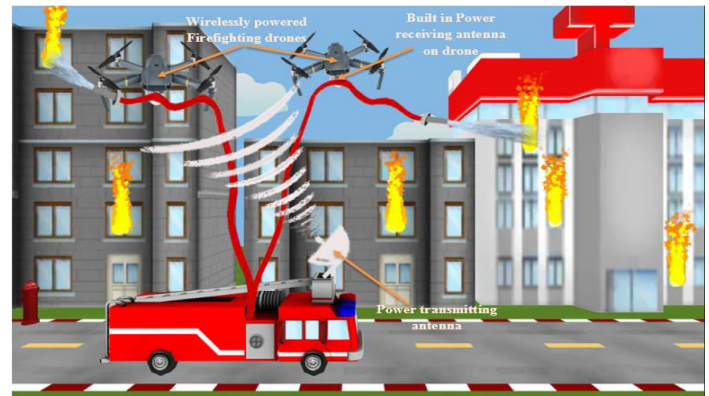
**Figure 12:** Wireless power supply to the house from green and clean power station.

### Power supply without wire from power station to the house

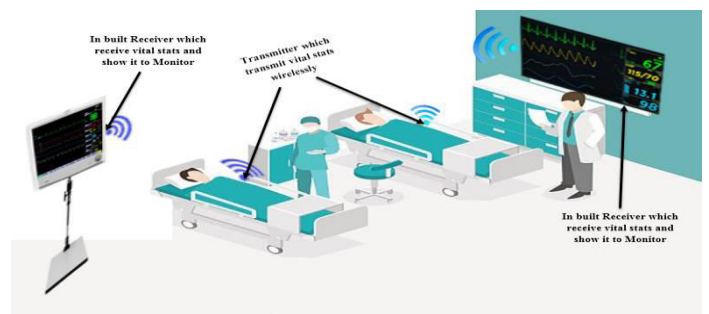
In the upcoming future, green and clean power generation might be done by using the renewable sources of energy. According to Figure 12, power might be supplied to our houses wirelessly. Power transmitting antenna connected with the power supply providing station then power transmitting antenna converts electric power into microwave then transmit it to the nearest dual-mode power transmitting and receiving antenna which transmits these microwave to the closest antenna that is connected to the nearest to the house. The house has its own power receiving antenna that converts these types microwaves into electrical power. This electric power than utilize by the house.

### Wirelessly controlling drone to extinguish the fire

In future, drones might be used for extinguishing the fire. The drone may carry the water pipes with them and set-up the pipes in its correct location which will be controlled by the people with the help of a remote control system. Figure 13 defines drone may get the power from the transmitter establish in the fire down car. The transmitter transmits power and the drone will have a receiver device that ill receives the power and work properly until the power has stopped. The drone is a very useful method for extinguishing fire because the places where people are unable to reach, drones can reach and can capture videos, pictures of the area situation. In any type of emergency, it is impossible to connect the drone with wire, so this process would be very useful.



**Figure 13:** Firefighting drones getting its power wirelessly from firefighting vehicle.



**Figure 14:** Wireless power transmission used for medical purpose.

### Wireless power apply to medical devices

In future wireless power supply in medical devices can be possible. There should be a transmitter that is to be directly connected with the power station. Figure 14 defines that the transmitter receives the signals from the power station and transmit it continuously. The transmitting power is received by the receiver, which are established in the hospital and generates electricity wirelessly. By using this electricity medical devices will be performed simultaneously. There will be some electrical devices in the patient's hand these devices show the status of that patient. Their physical status will show on the monitor. So, doctors find it easy to understand their condition and are able to take measurable steps quickly.

### Smart city powered wirelessly

According to Figure 15, a city can be made a smart city by using wireless technology. We can use power of the power station without wire through the transmitter and receiver. The transmitter transmits electricity through the power station and a receiver receives the power and supply the power to cars, trains, houses, offices even in the emergency areas where wired technology is not possible to set up. By using wireless technology, our environment can become carbon dioxide gas-

free. We will be getting benefited as our environment will be clean and will be free from harmful gases which are emitted from the car, train, or other vehicles.

### Conclusion

In the present day, we are using wireless technology like our phone, which is a major example of wireless technology but if we implement these methods for using modern technology without wire then our communication will be strong and smooth. Through this paper we have discussed many type of wireless power transmission technology and its various applications in our daily life. Moreover, we have presented and discussed the potential implementation of wireless power transfer technology to make our life easier.

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